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Taxonomic notes on some powdery mildews from Inner Mongolia

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Abstract—The new combination *Erysiphe atraphaxis* var. *pluriappendicis* is introduced; and the taxonomy of four powdery mildew species is reassessed. *Erysiphe rabdosiae* is reduced to synonym with *E. bunkiniana*, and *E. shinii* is considered to be identical with *E. thermopsidis*.

Key words—*Erysiphaceae*, China

Introduction

Based on results of rDNA sequence analyses, scanning electron microscopic examinations of conidia and a reassessment of anamorphs and teleomorphs, Braun (1999) and Braun & Takamatsu (2000) proposed a fundamental phylogenetic revision of generic circumscription within the *Erysiphaceae*. The new classification of the powdery mildew fungi, discussed and outlined in detail by Braun et al. (2002), has recently been recognized and applied in connection with a comprehensive taxonomic exploration of the powdery mildew fungi of Inner Mongolia in China (Liu & Braun 2006, Liu et al. 2006, 2007; Liu 2007, Liu & Shang 2008). Results of these studies have been summarized by Liu (2007). Taxonomic novelties in the latter unpublished thesis are, however, not effectively published. Therefore, the new combination *Erysiphe atraphaxis* var. *pluriappendicis* is here validated. Furthermore, rich, new collections of powdery mildew on *Rabdosia japonica* var. *glaucocalyx* and *Thermopsis lanceolata* from Inner Mongolia allowed taxonomic reassessments of *Erysiphe bunkiniana*/*E. rabdosiae* and *E. shinii* (≡ *Microsphaera thermopsidis*)/*E. thermopsidis*, respectively.

Materials and methods

Material was mounted in distilled water and examined using 100× oil immersion objectives (bright field and phase contrast), but without any staining, using standard light microscopy. For each collection, 30 measurements (× 1000 magnification) of conidia and other structures were made in water, with the extremes given in parentheses. Collections were deposited in the Mycological Herbarium of the Chifeng College, Inner Mongolia, China ("CFSZ"), the Mycological Herbarium of the Institute of Microbiology, Academia Sinica, Beijing, China (HMAS) and the Herbarium of Martin-Luther-University, Halle (Saale), Germany (HAL).

Taxonomy

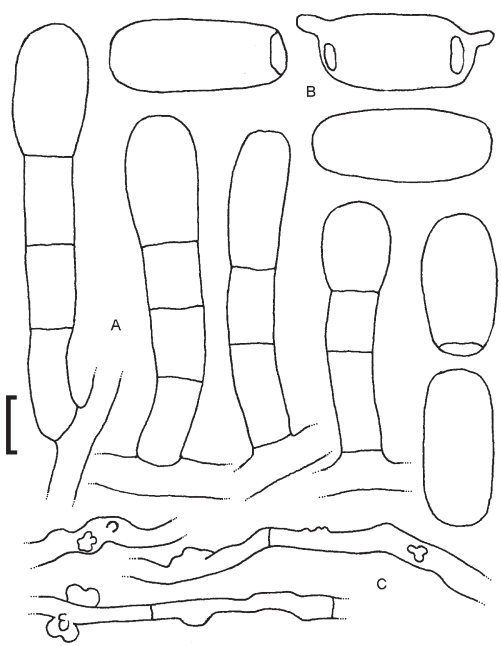

Fig. 1. *Erysiphe atraphaxis* var. *pluriappendicis*.
A. Conidiophores. B. Conidia. C. Hyphae with appressoria.
Scale bar = 10 µm. T.Z. Liu del.

(1) Reassessment of *Microsphaera atraphaxis* var. *pluriappendicis*

Erysiphe atraphaxis var. ***pluriappendicis*** (T.Z. Liu) T.Z. Liu & U. Braun, **comb. nov.** Fig. 1

MycoBank MB 513090.

Basionym: *Microsphaera atraphaxis* var. *pluriappendicis* T.Z. Liu [as '*atraphaxidis*'], Mycosystema 22: 195, 2003.

Specimens examined: CHINA. Inner Mongolia, Chifeng City, Hongshan District, Hongshan, on living leaves of *Atraphaxis manshurica* Kitag. (*Polygonaceae*), 24 Sep. 1995, T.Z. Liu (CFSZ 95122, HAL 2289 F, HMAS 74212); and 6 Oct. 2000, T.Z. Liu (CFSZ 00018); Chifeng City, Hexigten Banner, Darhan, 18 Jul. 2003, T.Z. Liu (CFSZ 03003).

Comments: Based on current genus-level taxonomy of the *Erysiphaceae* (Braun et al. 2002), *Microsphaera atraphaxis* var. *pluriappendicis* must be transferred to the genus *Erysiphe* DC. Since the anamorph of *E. atraphaxis* var. *pluriappendicis* was not previously described in detail, the following supplementary description is given:

Mycelium amphigenous, effuse or forming thin white patches, subpersistent. Hyphae 3–7 µm wide, hyaline or yellowish, smooth, thin-walled. Appressoria lobed. Conidiophores erect, cylindrical, foot-cells straight, 16.5–36 × 7–13 µm, followed by 1–3 shorter cells. Conidia formed singly, doliiform-cylindrical or subcylindrical, surface rugose, (22–)29–38(–46) × 11–23 µm.

(2) Taxonomy of *Erysiphe bunkiniana* and *E. rabdosiae*

Erysiphe bunkiniana U. Braun, Feddes Repert. 91: 441, 1980. Fig. 2

= *Erysiphe rabdosiae* R.Y. Zheng & G.Q. Chen, Sydowia 34: 276, 1981.

Specimens examined: CHINA. Inner Mongolia, Chifeng City, Aohan Banner, Daheishan, on living leaves of *Rabdosia japonica* var. *glaucocalyx* (Maxim.) Hara (*Lamiaceae*), 11 Aug. 1996, T.Z. Liu (CFSZ 96010); Chifeng City, Bairin Left Banner, Yezhugou, 18 Aug. 2005, T.Z. Liu & Y.J. Gao (CFSZ 05023, HAL 1937 F); Chifeng City, Harqin Banner, Wangyedian, 14 Sep. 1995, T.Z. Liu, (CFSZ 95076); Chifeng City, Ningcheng County, Heilihe, 15 Sep. 1995, T.Z. Liu (CFSZ 95102); Chifeng City, Songshan District, Wushijiazi, 24 Sep. 1996, T.Z. Liu & X.W. Gao (CFSZ 96074); Tongliao City, Horqin Left Back Banner, Daqinggou, 31 Aug. 2003, T.Z. Liu & Q. Wen (CFSZ 03023).

Comments: The anamorph of this species has been insufficiently known. The following supplementary description can be given:

Mycelium amphigenous, also cauligenous, forming distinct white patches, often occupying the whole leaf surface, persistent or subpersistent. Hyphae 3–7 µm wide, hyaline or yellowish, smooth, thin-walled. Appressoria lobed. Conidiophores erect, (65–)90–176 µm long, foot-cells cylindrical, straight, (16.5–)38–64 × 6.5–11 µm, followed by 1–3(–4) shorter cells. Conidia formed singly, doliiform-cylindrical or subcylindrical, 20–36(–42) × 10–18(–20) µm.

There are five species of *Erysiphe* described from *Rabdosia* (= *Isodon*, *Plectranthus*) spp., viz. *E. bunkiniana*, *E. hommae* U. Braun, *E. huayinensis* R.Y. Zheng & G.Q. Chen, *E. rabdosiae* (Zheng & Chen 1981, Chen et al. 1987, Braun 1987, Nomura 1997), and *E. plectranthi* H.D. Shin & Y.J. La (Shin & La

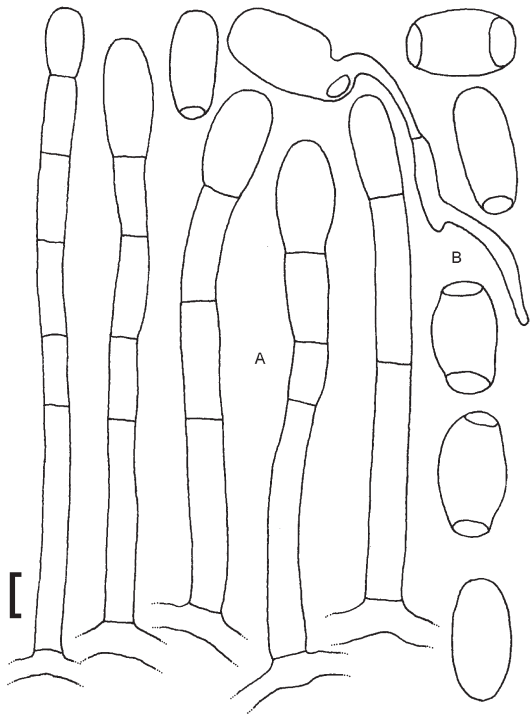

Fig. 2. *Erysiphe bunkiniana*. A. Conidiophores. B. Conidia.
Scale bar = 10 μm. T.Z. Liu del.

1989, Shin 2000, Liu et al. 2007). *Erysiphe bunkiniana* and *E. rabdosiae*, two species characterized by forming chasmothecial appendages with somewhat pointed tips, previously were differentiated by the length of the appendages and number of ascospores. *Erysiphe bunkiniana* was described as forming relatively long appendages, (0.5–)2–3 times as long as the chasmothecial diameter, and asci with (5–)6–8 spores, whereas *E. rabdosiae* was discriminated by somewhat shorter appendages, not exceeding a relative length of 0.5–2 times the chasmothecial diameter, and (3–)4–6(–7)–spored asci. Within the six specimens collected in Inner Mongolia, several collections [incl. CFSZ 95076, 05023 (= HAL 1937 F)] are fully intermediate between *E. bunkiniana* and *E. rabdosiae*, i.e. young, short appendages fully agree with *E. rabdosiae* and older, longer ones rather coincide with those of *E. bunkiniana*. The whole range of the number of ascospores per ascus is also fully overlapping. Based on the

morphological continuum between powdery mildew collections on *Rabdosia* spp. previously referred to as *E. bunkiniana* and *E. rabdosiae*, it became evident that only different developmental stages of a single species have been involved. It is proposed to reduce *E. rabdosiae* to synonym with *E. bunkiniana*.

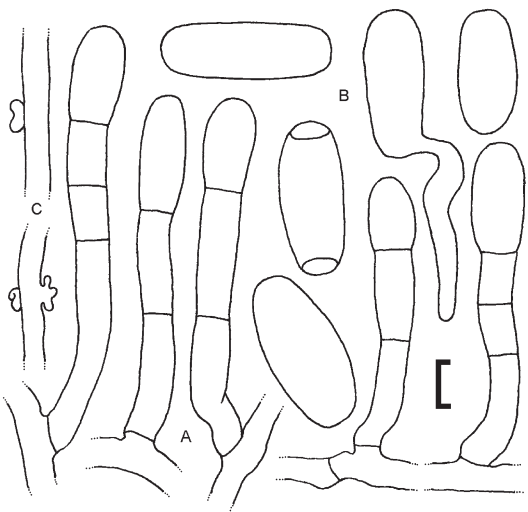

Fig. 3. *Erysiphe thermopsidis*. A. Conidiophores. B. Conidia. C. Hyphae with appressoria. Scale bar = 10 μm. T.Z. Liu del.

(3) Taxonomy of *Erysiphe thermopsidis* and *E. shinii*

Erysiphe thermopsidis R.Y. Zheng & G.Q. Chen, Sydowia 34: 287, 1981. Fig. 3

= *Microsphaera thermopsidis* U. Braun, Mycotaxon 20: 491, 1984.

≡ *Erysiphe thermopsidis* (U. Braun) U. Braun & S. Takam. [as '*thermopsis*'], Schlechtendalia 4: 14, 2000, non R.Y Zheng & G.Q. Chen, 1981.

≡ *Erysiphe shinii* U. Braun & S. Takam., in Braun, Schlechtendalia 8: 34, 2002.

= *Trichocladia diffusa* f. *thermopsidis* Jacz., Karmannyj opredelitel´ gribov, Vyp. 2, Muchnisto-rosjannye griby: 316, Leningrad.

≡ *Microsphaera diffusa* var. *thermopsidis* (Jacz.) T.Z. Liu, in Liu & Zhu, Mycosystema 17: 299, 1998.

Specimens examined: CHINA. Inner Mongolia, Baotou City, Xilamuren, on living leaves of *Thermopsis lanceolata* R. Br. (*Fabaceae*), 29 Sep. 2004, T.Z. Liu, (CFSZ 04134); Chifeng City, Hongshan District, Nanshan, 13 Oct. 1994, T.Z. Liu & X.W. Gao (CFSZ 94027); 5 Nov. 1994, T.Z. Liu & X.W. Gao (CFSZ 94060); 5 Sep. 1995, T.Z. Liu (CFSZ 95036, HAL 2287 F); 2 Oct. 1995, T.Z. Liu (CFSZ 95145, HMAS 74213); Hohhot City, Zhaojun Mu, 25 Sep. 2004, T.Z. Liu (CFSZ 04103); Hulun Buir City, Hailar District, 2

Aug. 2006, T.Z. Liu (CFSZ 06033, HAL 2288 F); Ordus City, Dalad Banner, Engbei, 22 Sep. 2006, T.Z. Liu (CFSZ 06123, CFSZ 06127); Ordus City, Ejin Horo Banner, Qinggis Han's Mausoleum, 31 Aug. 1999, T.Z. Liu (CFSZ 99009); Ulanqab City, Tsining District, Laohushan, 16 Oct. 2005, T.Z. Liu (CFSZ 05373); Xilin Gol League, Plain Blue Banner, Herisutai, 19 Aug. 2005, T.Z. Liu & X.L. Bai (CFSZ 05038); Yihehaierhan, 21 Aug. 2005, T.Z. Liu & X.L. Bai (CFSZ 05059).

Comments: The following supplementary description of the insufficiently known anamorph of this species is given:

Mycelium amphigenous, forming irregular white patches, eventually occupying the whole leaf surface, persistent. Hyphae 3–8 µm wide, hyaline. Appressoria lobed. Conidiophores erect, foot-cells cylindrical, straight or slightly flexuous at the base, 23–50 × 7–10 µm, followed by 1–3 shorter cells. Conidia formed singly, doliiform, doliiform-cylindrical or cylindrical, surface rugose, (16.5–)23–33(–40) × 9–17 µm.

Zheng & Chen (Chen et al. 1987) discussed the differences between *Erysiphe thermopsidis* and *E. shinii* (≡ *Microsphaera thermopsidis*) in detail. Differentiation of the two species was based mainly on the length and morphology of the appendages. 13 powdery mildew specimens on *Thermopsis lanceolata* have been collected from different localities of Inner Mongolia. Most collections represent the *Erysiphe shinii* (≡ *Microsphaera thermopsidis*) type, i.e. they are characterized by having relatively long, often terminally branched chasmothecial appendages. However, even in these specimens long and branched appendages are mixed with short, unbranched ones, agreeing with those described for *Erysiphe thermopsidis*. Only three collections, viz. CFSZ 05038, 05059 and 06033 (= HAL 2288 F), represent the *E. thermopsidis* type, although some longer, 1–2(–3) times dichotomously branched, *E. shinii*-like appendages have also been observed. Furthermore, there are no distinct differences in the anamorphs of *E. shinii*- and *E. thermopsidis*-like collections. Therefore, it can be concluded that *E. thermopsidis* was based on immature, not yet fully developed, samples. The two morphological types represent two extremes of a morphological continuum within the variation of a single species. Therefore, it is proposed to merge the two species under the older valid name *E. thermopsidis*.

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